SEU Theme Update

Presentation to SEUS

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July 1, 2003

Outline

- SEU Mission Status
  - Recent Press Activity
- BE Overview
  - Plans for BEPO
  - Report on TRIP
  - Preview on IWG
  - Prognosis for Probes
- Vision Mission Concepts NRA
- Beyond Einstein E/PO

Astronomy and Physics
Operating Missions Status

	Launch/Phase	Apr	May	Jun	STATUS
HST	04/25/90 Prime	GRN	GRN	GRN	
Rossi XTE	12/30/95 Extended	GRN	GRN	GRN	
2MASS	04/01/97 Extended	GRN	GRN	GRN	
SWAS	12/3/98 Extended	GRN	GRN	GRN	
FUSE	06/24/99 Extended	GRN	GRN	GRN	
Chandra XO	7/19/99 Prime	GRN	GRN	GRN	High solar radiation event on 5/31 caused loss of 95 ksec science time. Cycle 5 review week of 6/22.
XMM-Newton	12/09/99 Prime	GRN	GRN	GRN	
HETE-2	10/08/00 Extended	GRN	GRN	GRN	
WMAP	06/30/01 Prime	GRN	GRN	GRN	
Integral	10/17/02 Prime	GRN	GRN	GRN	
CHIPS	1/15/03 Prime	GRN	GRN	GRN	
GALEX	4/28/03 Prime			GRN	

GRN Proceeding on Plan, only normal, minor problems

Structure and Evolution of the Universe
Developmental Mission Status

	Launch	Apr	May	Jun	STATUS
GP-B	**Nov '03**	**RED**	**YEL**	**YEL**	Completed penalty T/V, accessing results. Star tracker anomaly reoccured. SIM 5 went very well.
SWIFT	**Dec '03**	**GRN**	**YEL**	**YEL**	Launch date moved to January 15, 2004. BAT has no schedule reserve.
Astro-E2	**Feb '05**	**YEL**	**YEL**	**YEL**	XRS PER held June 19, 2003, XRT vibration anomaly being investigated.
SPIDR	**Jun '05**	**RED**	**BLK**		Termination Letter sent to PI and GSFC on May 16th.
GLAST	**Sep '06**	**GRN**	**YEL**	**YEL**	NAR successfully held June 3-5, 2003. Addressing findings.
Herschel	**2007**	**GRN**	**GRN**	**GRN**	SPIRE kevlar suspension system having manufacturing problems.
Planck	**2007**	**GRN**	**GRN**	**GRN**	Cryocooler meeting held with ESA. Potential solution developed.
EUSO	**2008**			**GRN**	Recently selected Explorer Mission of Opportunity for ESA ISS mission.
LISA	**2011**	**GRN**	**GRN**	**GRN**	List and mgmt meeting schedule for July 5-9, 2003 in Pisa, Italy.
Con-X	**2013**	**GRN**	**GRN**	**GRN**	All technology areas progressing well.
Balloons	**Ongoing**	**GRN**	**GRN**	**GRN**	Flew 70 marble Hall of Fame presentation gauges to replace set lost on Columbia.

GRN	Proceeding on Plan, only normal, minor problems
YEL	Significant Problems or Concerns but feasible plan to resolve
RED	Major Problems; Solution path unclear

SWIFT

ISSUE (Reason for Yellow Status)

- BAT instrument has no schedule slack.

OSS PLAN OF ACTION

- BAT will be delivered on July 28 to spacecraft.
- New wiring harness has been built and is in test.
- All other known problems have been resolved.
- Reasonable overtime schedules being worked.
- Maximum attention being given to the schedule!!!
- No reason to believe that BAT will not be delivered on time.

Astro E2

ISSUE (Reason for Yellow Status)

- Cryostat dewar leaked during cold checkout delaying start of Cryostat performance testing. This is the critical path item.
- **Impact** - Delayed performance testing and subsequent delivery of Cryostat to I&T.

Status

- Leak found and verified. It is in the Indium seal between the periscope and magnetic mandrel. No other leaks exist. Repaired and retested. Pre-Environmental Review held June 19, 2003.

OSS PLAN OF ACTION

- Impact analysis should be complete by mid-June. Expected to be within available cost and schedule reserves. Lost ~1 month schedule reserve.
- ISAS informed of likely use of some schedule reserve.

GLAST

ISSUE (Reason for Yellow Status)

- CNES informed NASA of decision not to fund Large Area Telescope calorimeter work. Mission PDR and NAR held. Issues being addressed. About five month additional schedule reserve recommended.
- **Impact** - Affects cost and schedule.

OSS PLAN OF ACTION

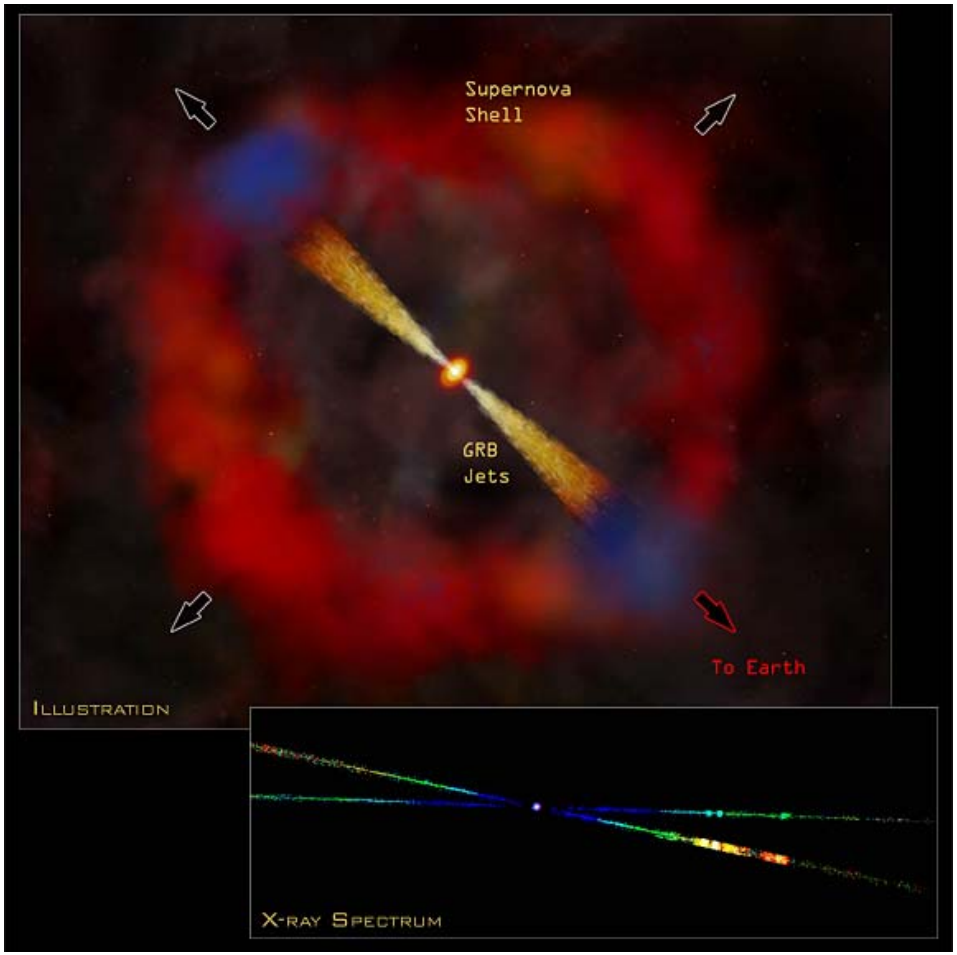
- CDE work brought to U.S. Funding shared between NASA and DOE.
- Preparations for Confirmation Review continuing.
  - **July 30 - with OSS AA**
  - **August 4 - with NASA PMC**

Recent Press Activity

- July 2 – Discovery about Pulsars
- June 18 – Rosetta Stone Decodes Gamma-Ray Burst Mystery
- June 19 – The Secret Lives of Galaxies Unveiled in Deep Survey
- May 26 – Chandra Finds Rich Oxygen Supply Inside Glowing Ring
- May 26 – Chandra Adds to Story of the Way We Were
- May 26 – Major survey suggests finding intermediate-mass black holes will be a challenge
- May 21 – Chandra Provides New View of Biggest Construction Sites in Universe
- May 8 – Stephan's Quintet: Intruder Galaxy Shocks Tightly-Knit Group
- April 22 – NASA Galaxy Evolution Explorer Looks Back In Time
- April 14 – X-rays Found From a Lightweight Brown Dwarf
- March 31 – NASA Detects One of the Closest and Brightest Gamma-Ray Bursts

- March 25 – Chandra Sees Shape of Universe During Formative, Adolescent Years
- March 25 – Doomed Matter Near Black Hole Gets Second Lease on Life
- March 24 – Cosmic Forensics Confirms Gamma-Ray Burst and Supernova Connection
- March 24 – New Class of Hot-Tempered Black Holes Bucks Trend
- March 19 – Race to Gamma-Ray Burst Reveals Gigantic Explosion, Death & Birth
- March 12 – Chandra Image Reveals Supernova Origin

Science Highlights:
HETE-2 and Chandra

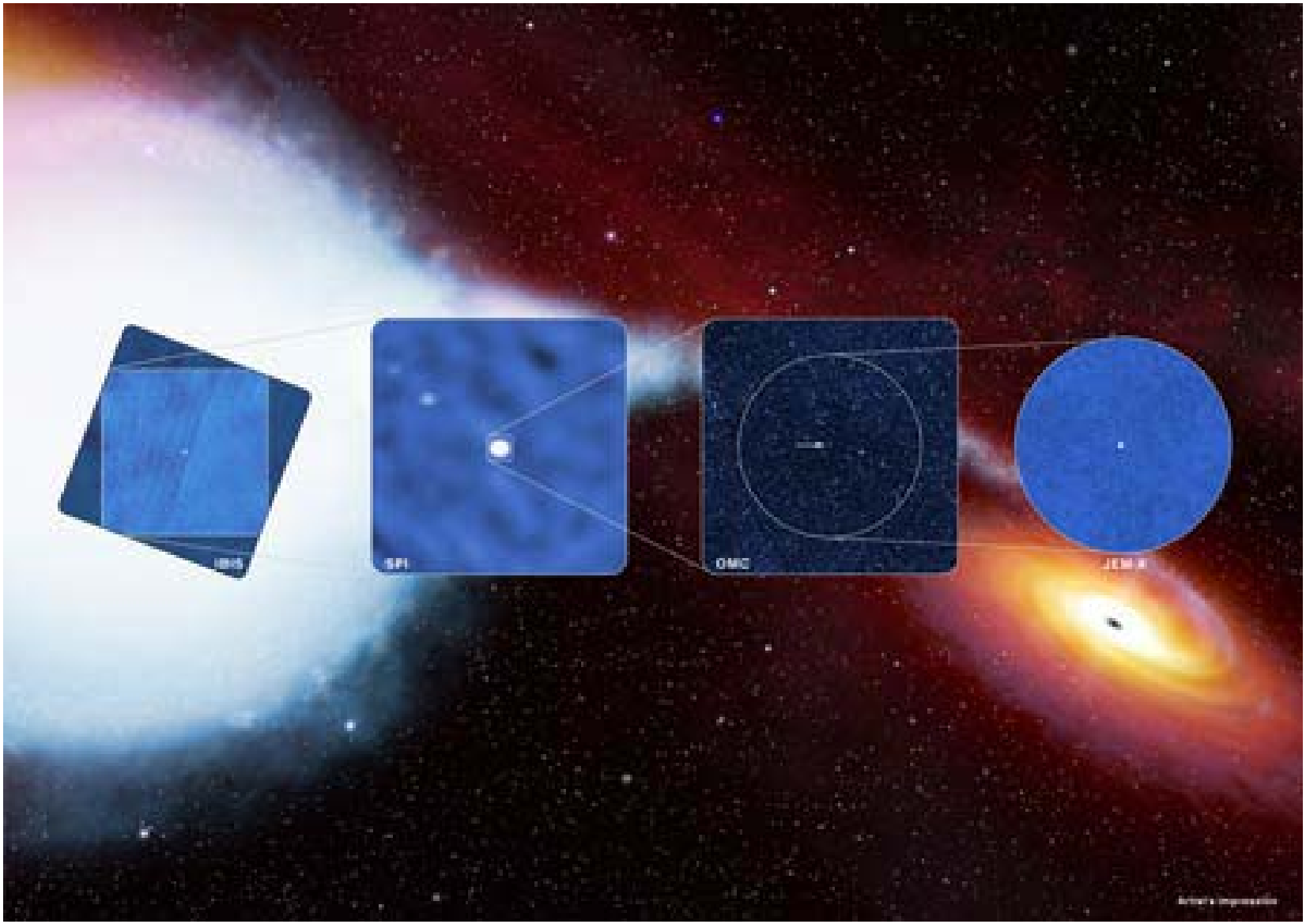


GRB Associated with Supernova

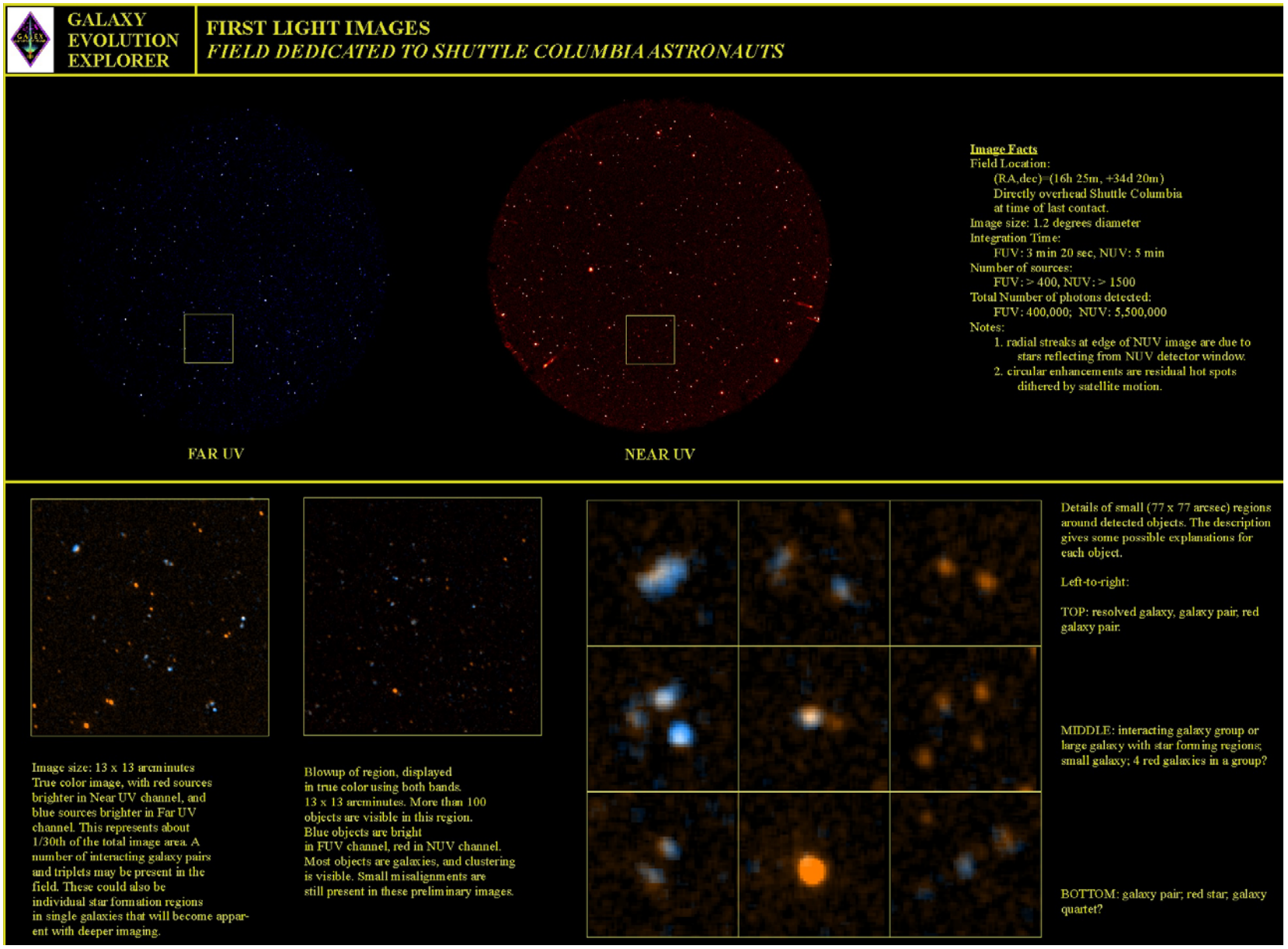
- GRB020813 is HETE detected long duration burst.
- Chandra HETGS spectral observations of afterglow 21 hours after burst.
- Lines of low -z metals (S and Si) associate burst with a supernova.
- Lack of iron suggest burst occurred < 2 months after supernova (Ni^{56} -> Si^{56} -> Fe^{56})

6d 78d

Science Highlights:
INTEGRAL First Light - Cygnus X-1



Science Highlights:
GALEX First Light



Beyond Einstein Overview

- President's 2004 Budget
- Beyond Einstein Program Office
  - Includes Education/Public Outreach Program
- Formulation for LISA and Con-X
  - Based on TRIP Report and Evaluation
- Einstein Probes
  - Concept studies and Interagency Coordination

Plans for Beyond Einstein Program Office

- NASA will establish a BEPO at GSFC
  - Will provide integrated management of BE and SEU programs
- Includes
  - LISA and Con-X Projects
  - Einstein Probes: Concept studies, technology programs, (eventually) flight projects
  - BE E/PO including coordination with other SEU missions
- Synergistic with
  - GLAST project
  - SEU theme integration and technologist
  - Support for SEU public affairs and space science updates
- Schedule
  - Establish this summer, includes moving LISA and Con-X into Phase A

Report on TRIP

- October 2002: Request for Reports
- February 3, 2003: Reports due to NASA
- February 2003: Preliminary review, telecons
- March 4-5, 2003: Con-X Initial Plenary
- March 6-7, 2003: LISA Plenary
- March 20, 2003: Con-X Site Visit @ GSFC
- March 21, 2003: Con-X Final Plenary
- April 1, 2003: LISA Site Visit @ GSFC
- April 2, 2003: LISA Final Plenary
- April 18, 2003: Evaluation reports due to NASA HQ
- April 22, 2003: Evaluation Report briefed to Kinney
- May 2, 2003: Debrief LISA and Con-X Projects

Report on TRIP
INTRODUCTION

- TRIP objectives / Panel Charter
  - Identify the key milestones and challenges
  - Determine the current mission technology and feasibility of the technology roadmap to achieve readiness for flight
  - Assess the feasibility of the plan for completing formulation
  - Assess the feasibility of the plan for completing implementation, including cost, schedule, and launch date realism.
- Approach
  - Panel reviewed the project TRIP report.
  - Report was discussed via telecon, and plenary meeting where strengths and weaknesses, and questions were generated
  - Panel participated in the site visit and tour at JPL (LISA) or GSFC (Con-X)
  - Many hours of panel discussion, including post-site visit plenary meeting, leading to the report

LISA Review Panel Members

John Hrastar(Chairman)	Consultant/Retired NASA
Alan Bunner (Co-Chairman)	Consultant/Retired NASA
Robert Bitten	Aerospace Corp.
Edgar Choueiri	Princeton University
John Dec	NASA/LaRC
Lou Demas	Consultant/Retired NASA
Charmaine Gilbreath	Naval Research Laboratory
John Hall	NIST/JILA
Virginia Hall	Hall Consulting
Jerre Hartman	Consultant/Retired NASA
Bob Hayduk	Consultant/Retired NASA
Jonathan How	MIT
Siegfried Janson	Aerospace Corp.
Ken Johnston	U.S. Naval Observatory
Mark Kahan	Optical Research Associates
Andrew Keys	NASA/MSFC
John Ries	University of Texas
Steve Sandford	NASA-Langley
Byron Tapley	University of Texas
Rainer Weiss	MIT

LISA-TRIP

TECHNOLOGY ROADMAP

CONCLUSIONS

- LISA has a very healthy technology program (~$300M) between NASA and ESA.
- The technology planning is well thought through with various options available.
- The SMART-2 mission represents an excellent opportunity for risk reduction.
- The integrated modeling approach is well thought through.
- Significant technical challenges remain
  - Can't experimentally test many systems
  - Microthruster contamination and lifetime
  - Must predict performance through models anchored by SMART-2 data
  - Reducing GRS noise by a factor of 100
- Budget reserves are low for FY03-05
- Achieving TRL 6 by 2006 will be a challenge; little schedule slack

Risk of achieving the Technology Roadmap: Medium

LISA-TRIP
FORMULATION

CONCLUSIONS

- Excellent working relationship between NASA and ESA
- Quality of the LISA team is high.
- Many special features (e.g., free-floating proof masses) can't be tested before launch. Therefore, thorough end-to-end modeling of performance is required.
- The mission reliability/redundancy trade must be done. Consider a fourth spacecraft?
- The initial acquisition process is critical and complex. Backups are necessary.
- A successful (at least partially) SMART-2 flight is critical to proceeding to LISA implementation

Risk of completing the Formulation: Medium

LISA-TRIP
IMPLEMENTATION

CONCLUSIONS

- The conclusion of the SMART-2 flight in April 2007 provides only a short time to impact the LISA design.
- Schedule reserves in such areas as observatory I&T and constellation testing are only modest for this complex program.
- Integrated modeling will be essential to extend the results from testing and SMART-2 to LISA
  - The project has a good modeling approach
- The systems engineering approach is strong and well integrated with the scientists. This is a major strength.
- The LISA team is strong and the overall planning and approach is well thought through.

Risk of completing the Implementation: Medium

LISA-TRIP
SUMMARY

- LISA has major technology challenges in the Disturbance Reduction System (DRS) and Inertial Measurement System (IMS) specifically.
- Plans to move the TRL's from the levels 2-4 to TRL 6 by 2006 are optimistic.
- The SMART- 2 mission will mitigate LISA technical risk.
- The planning and approach are well thought through.
  - Multiple paths for technology development
  - Good approach on integrated modeling
  - Very strong and integrated team
- The schedule is tight because there is little time between the technology development, including the SMART-2, and the LISA CDR.
- The technology budget is robust but there are some reserves problems and funding profile issues.

Con-X Review Panel Members

Marius Weinreb (Chair)	MBW Inc/Retired NASA.
Alan Bunner (Co-Chair)	Consultant /Retired NASA
Jeff Bloch	Los Alamos National Lab.
Leonard Brownlow	The Aerospace Corporation
Steve Castles	Consultant/Retired NASA
Lou Demas	Consultant/Retired NASA
Richard Griffiths	Carnegie Mellon Univ.
Virginia Hall	Hall Consultants
Richard Harms	RJH Scientific, Inc.
Jerre Hartman	Consultant/Retired NASA
Mark Kahan	Optical Research Associates
David McKenzie	The Aerospace Corporation
Jim Ryan	Univ. of New Hampshire
George Seidel	Brown University
Peter Ulrich	Consultant/Retired NASA
Steve Vernon	Lawrence Livermore National Lab.

Feasibility of Technology Roadmap

- Review Panel Rates Risk of Completing Technology Roadmap as MEDIUM
  - Project Presents an excellent Technology Roadmap that Identifies the Right Technology Issues
  - Number of Technology Advances that must be Developed Early and in Parallel Strain the Schedule and Budget
  - Major Drawback Identified by the Review Panel is Insufficient Early Funding
  - Review Panel Recommends Increasing FY'04 Funding to Mitigate Schedule Risk of Completing the Technology Roadmap

Formulation in Addition to Technology Development

- The Review Panel Rates the Risk in Completing Formulation as MEDIUM/LOW
  - GSFC and SAO Have High Quality Team in Place with Comprehensive Plan for the Formulation Phase
  - The Described Mission is Well Planned, but Some Technical Issues Need Early Additional Funding
  - As Recognized by the Project, Mass Producing Optics Components and Transferring that Technology to Industry Vendors Requires Additional Planning
  - Provision of Additional Early Year Funding and Addition of Schedule Reserve would Reduce Risk to Low

Plan for Mission Implementation

- Review Panel Rates the Risk of Completing the Implementation Phase as MEDIUM
  - Well Thought out and Comprehensive Mission Implementation Plan; Technical Plan is Very Solid
  - Mission is Ideally Suited to the Capable and Experienced GSFC-SAO Team
  - GSFC Management has Shown Strong Support for the Con-X Project

Summary

- GSFC and SAO are a Strong Team, Experienced in X-Ray Astronomy Missions
- The Mission has Strong Support from GSFC Management
- The Project Benefits from a Rich Heritage While at the Same Time Pushing the Envelope in Several Key Technology Areas
- The Schedule and Budget Reserves are Low, Especially Earl Year Funding
- The Review Panel Feels that with Added Budget and Schedule Reserves, Con-X has a High Likelihood of Reaching the Launch Pad Successfully and on Time

Preview on IWG

- National Science and Technology Council, Committee on Science, created an Interagency Working Group on the Physics of the Universe
  - Provide government response to the Turner Committee report
  - Co-chairs: Dehmer (NSF), Kinney (NASA), Rosen (DOE)
- Report contains
  - Current government programs of relevance to Turner's 11 questions
  - Recommended actions in seven themes
  - Goals for multi-agency investment
- The IWG report is directly relevant to SEU and Beyond Einstein
  - LISA and Con-X address Gravity theme
  - Einstein Probes address Dark Energy and Birth of the Universe themes
  - GLAST addresses High Energy Cosmic Rays/Gamma Rays theme
- Pat Looney (OSTP) will provide full briefing

Prognosis for Probes

- Proposals received for Einstein Probes Mission Concepts
  - Multiple proposals in all categories and types
  - Planning for peer review under way
  - DOE will be advising/commenting/observing review of Dark Energy Probe proposals in anticipation of future collaboration on a dark energy mission
- President's 2004 Budget includes funding for Einstein Probes beginning in 2007
  - Without augmentation, first launch would be in ~2016

Prognosis for Probes

- Discussions with DOE on ways of jointly sponsoring a dark energy mission
  - Science is high priority to both agencies, both agencies are interested in a space-based investigation
  - Difficult questions of management, funding, selection, etc. are being resolved –- prognosis is excellent for interagency cooperation
- Mission concept studies will lead to technology roadmaps
  - Code R NRA for Mission and Science Measurement Technology supports technology for Einstein probes and Vision Missions
- NASA and DOE will work for accelerating the Probes relative to President's 2004 Budget

Vision Mission Concepts

- Call for Mission Studies: Space Science Vision Missions
  - ROSS NRA amendment
  - Proposals due September 12
- Goals
  - Better understanding of far term missions
  - Provide requirements for agency wide planning, especially astronauts
- 17 Vision Missions drawn from 5 Theme Roadmaps. Includes
  - Big Bang Observer, Black Hole Imager
  - Advanced Compton Telescope, Generation-X
  - Far Infrared Telescope, Optical and Ultraviolet Telescope, Far Infrared and Submillimeter Interferometer
- Expect ~12 selections over 5 themes
  - $3M for 12 month studies
  - Includes credit toward use of JPL or GSFC design centers (Team-X, IDC)